DOCUMENT RESUME

ED 337 492 TM 017 328

TITLE	The Massachusetts Educational Assessment Program: 1990 Statewide Summary.
INSTITUTION	Massachusetts State Dept. of Education, Boston.
PUB DATE	Nov 90
NOTE	56p.; For a related report, see TM 017 327.
PUB TYPE	Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Achievement Tests; Administrator Attitudes; *Educational Assessment; Grade 4; Grade 8; Grade 12; Intermediate Grades; Multiple Choice Tests; Scores; Secondary Education; *Standardized Tests; *State Programs; State Surveys; Student Attitudes; *Student Evaluation; Teacher Attitudes; *Testing Programs; Test Results
IDENTIFIERS	*Massachusetts Educational Assessment Program; Open Ended Questions

ABSTRACT

Results of the third administration of the Massachusetts Educational Assessment Program (MEAP), a statewide testing program for fourth-, eighth-, and 12th-grade students, are summarized. The assessment contains multiple-choice and open-ended questions in reading. mathematics, science, and social studies. In 1990, approximately 155,000 students completed the assessment tests. Students included in school reports are 55,603 fourth-graders, 50,150 eighth-graders, and 49,032 12th-graders. In addition, students, teachers, and principals completed questionnaires about their attitudes and practices related to education. MEAP tests are not designed to measure achievement at a particular grade; they are meant to assess learning up to and including each grade level and are designed to measure a body of knowledge and kinds of thinking that content experts believe are essential to the subject area taught. Each student completes a fraction of test questions for any grade level, and results are aggregated at the school and district levels. Responses to sample open-ended questions are provided, with an analysis of results. Proficiency scales that describe students' performance at various levels of achievement are presented, which provide a link between the scaled scores reported to the schools and the actual test items that characterize the levels of knowledge and skill. An appendix provides descriptions of student performance at levels of proficiency for all three grades. (SLD)

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CHAPTER 188

Massachusetts Educational Assessment Program

November 1990

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The Massachusetts Educational Assessment Program:

1990 Statewide Summary

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The Massachusetts Educational Assessment Program:

1990 STATEWIDE SUMMARY

MASSACHUSETTS DEPARTMENT OF EDUCATION

FOREWORD

The Massachusetts Educational Assessment Program was established in 1985 to improve the education of students throughout the Commonwealth. It accomplishes this goal in two ways: by providing public information about the relative performance of schools and districts throughout the state and by providing detailed information to schools and districts about factors that affect student achievement.

In the five years since its inception, the program has developed and refined both its vision and its strategies. This third cycle of the assessment reflects some of these developments. For example, in response to public concern about actual attainment among students, as distinct from relative performance among schools, the program has instituted a more descriptive measure of achievement. Levels of proficiency, clearly delineating what students can and cannot do, have been defined for each of the subject areas tested. Percentages of students at each of these levels of proficiency are reported for the state, as well as for each school and district. Their purpose is not only to increase the utility of the school and district reports, but to serve as a criteria for success of elementary, middle, and secondary instruction. As such, they can provide clear goals for achievement throughout the Commonwealth.

Another important development, related to the quality of attainment that we expect of our students, is the increased emphasis on open-ended testing in the assessment. As our society shifts in character from a stable manufacturing base to a fluid informational one, different abilities are required. These open-ended questions, which tap deeper and more flexible understanding of the subjects tested, reflect the kinds of thinking that constitute the survival skills of such a society.

As the goals of education change in response to new social and economic forces, the Massachusetts Educational Assessment Program is attempting to supply the kinds of information most needed in forming educational policies that effectively support those changes.

Harold Raynolds Jr

Commissioner of Education

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ACKNOWLEDGEMENTS

The Massachusetts Educational Assessment Program would not have been possible in its present form without the generous support of many individuals and school districts throughout the state. Since its inception in 1985, four Curriculum Advisory Committees have worked to develop the assessment framework, to review the test items, to interpret the results, and to give guidance and support to the entire effort.

We wish to pay special tribute to these committee members who contributed so much to this process. We are also grateful to the school districts that supported their efforts by granting release time during the school year. The efforts of the one, the support of the other, has resulted in an assessment program that not only reflects the values and academic aspirations of Massachusetts educators, but the most profound thinking in each of the content areas.

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EXECUTIVE SUMMARY

This report summarizes results of the third administration of the Massachusetts Educational Assessment Program (MEAP), a statewide testing program administered to fourth, eighth, and twelfth grade students across the Commonwealth. Authorized by Chapter 188, the Assessment includes both multiple-choice and open-ended questions in reading, mathematics, science, and social studies. Participants in the program — students, teachers, and principals at grades 4, 8, and 12 — also complete questionnaires focusing on attitudes and practices related to education, the school climate, and other factors shown to be correlates of achievement.

Test objectives and the frameworks which form the basis for the MEAP tests were developed by curriculum committees in each subject area. An initial curriculum survey, sent to all schools and districts in Massachusetts before the tests were developed in 1986, was designed to ensure that the coverage of subjects and the relative emphases placed upon topics within each subject accurately reflected the curricula of the state's schools. With this guidance, test items were selected from such sources as the National Assessment of Educational Progress and other programs or were newly-developed for these tests.

The MEAP tests are not designed to measure achievement at a particular grade; they include a range of questions that are meant to assess learning up to and including each grade level. Similarly, they are not designed to measure a specific curriculum, but the body of knowledge and kinds of thinking that content experts believe essential to the subject area tested. Each student completes a fraction of the total number of test questions asked at any grade level, and results are aggregated at the school and district level.

Two new measures have been added to MEAP reports this year: results on the open-ended questions completed by a sample of students at each grade and proficiency scales that describe students' performance at various levels of achievement. The proficiency scales provide a link between scaled scores reported to the school and districts and actual test items that characterize those levels of knowledge and skill.

The background and administration format for the Massachusetts Educational Assessment Program are described in Chapter 1 of this report; Chapter 2 reviews some of the responses to questionnaire items; Chapter 3 provides an overview of response to open-ended questions and Chapter 4 gives information about the MEAP proficiency scales.

A Summary of Findings from the Massachusetts Educational Assessment Program

Chapter 1:

- Some 155,000 students in grades 4, 8, and 12 completed the assessment tests.
- The total number of test questions asked at each grade level is:

Grade 4	875
Grade 8	1,076
Grade 12	1,444

Chapter 2:

- Student questionnaires revealed information about student attitudes and activities and the correlations with their scores on the assessment. Whether or not the student likes school, absenteeism, time spent reading for pleasure, and time spent on homework were examined. Other demands on student time outside of school, such as viewing television and employment were also related to the student scores.

- There is a significant difference between the time estimated by teachers who assign homework and the time spent by students in completing those assignments. Only 23 percent of the students in grade 8, for example, report that they spend more than two hours per week on mathematics homework, while over 40 percent of the teachers give assignments that require at least that level of effort; at grade 12, the corresponding figures are 25 percent of the students and 60 percent of teachers who report doing/assigning more than two hours of homework each week.

- Teacher questionnaires show that the aging of the teaching force is a significant problem that must be addressed by Massachusetts in coming years. Between 38 and 46 percent of teachers at all grade levels have been in the classroom for 20 years or more.

- Almost two thirds of the teachers in both grades 8 and 12 report that student indifference and lack of motivation is a "very important" reason for students not making satisfactory academic progress. Other important reasons cited by more than one third of the teachers at these levels are poor preparation prior to entering class and student absenteeism. At Grade 12, 30 percent cited too many outside demands on student time.

Chapter 3

- **Open-ended Reading:** Fourth and eighth grade students demonstrated that they are familiar with the demands and structure of the narrative genre and bring an appropriate frame of reference to their work when reading narratives. Students also showed that they are skilled in making inferences about the text from context clues and support their inferences with evidence. Students in grade 12, however, generally showed less skill with both external and internal analysis of text.

- **Open-ended Social Studies:** Questions presented in this subject area required fourth grade students to synthesize analytical and map-reading skills by translating a route on a map to a written set of directions and explored their sense of history in questions asking them to compare colonial with contemporary life. At grade 8, the tasks included interpreting a political cartoon, as well as producing and evaluating various courses of action in regard to an environmental problem. Grade 12 students were asked to interpret data presented on a graph and draw conclusions based on that data. Results at all grade levels were mixed.

- **Open-ended Science:** Fourth graders exhibited an awareness of scientific terms such as "evaporation," "condensation," and "erosion," but were not able to elaborate on the meanings of the terms or accurately describe the processes involved. At eighth grade students were asked to recognize adaptation and to explain natural phenomenon. Grade 12 results support findings of multiple-choice questions in the assessment, showing that students recognize elements of the scientific process but fail to apply that knowledge in practical situations.

- **Open-ended Mathematics:** At fourth grade, the questions involved, among other things, fractions and spatial visualization. Eighth graders were asked to coordinate graphical material and to recognize sequential patterns. Grade 12 mathematics also examined students' understanding of factorials.

Chapter 4

- The MEAP proficiency scales have been developed to describe students' performance on a scale that is related to the school and district scaled scores. Four levels of proficiency are defined and illustrated by selected items: 950, 1250, 1550, and 1850. Descriptions for each level were developed by committees of Massachusetts teachers who identified skills that were evident at each level but lacking at the next-lower level. While the styles of thinking that characterize each level are similar across grades, the types of skills and content knowledge differ.

- In addition to relating test questions to proficiency levels, this report also links school and outside factors (as reported in student questionnaires) to attainment of each level. The factors examined include access to a computer, attitudes toward school subjects and course-taking.

CHAPTER 1: BACKGROUND TO THE MASSACHUSETTS EDUCATIONAL ASSESSMENT PROGRAM

The Massachusetts Educational Assessment Program (MEAP) is one of two statewide testing programs mandated by Chapter 188 of the Acts of 1985. The purpose of the assessment program is twofold: to furnish information to improve curriculum and instruction in Massachusetts schools; and to provide reliable results for comparisons at the school, district, and state levels. It does not produce scores for individual students. The Massachusetts Basic Skills Testing Program, the second program created by Chapter 188, is designed to identify individual students who may need assistance in mastering basic skills in reading, writing, and mathematics.

Under the mandates of Chapter 188, the Massachusetts Educational Assessment Program tests all students at three grade levels in major subject areas biennially. Massachusetts students in grades 3, 7, and 11 participated in the first round of MEAP testing in April 1986; they were assessed in reading, mathematics, and science. School, district, and state results were released the following November.

The second statewide assessment was administered to students in grades 4, 8, and 12 in April of 1988; the subjects assessed were reading, mathematics, science, and social studies. The selection of grade levels, test administration times, and subjects is guided by the mandate of Chapter 188 that the performance of Massachusetts students be compared with that of their peers nationally. The change in grade levels between the first and subsequent MEAP administrations, and the addition of social studies, were undertaken to conform to the plans of the National Assessment of Educational Progress (NAEP). Test questions from the National Assessment are used as part of the MEAP results and provide the basis for national comparisons. Other questions are developed specifically for the Massachusetts tests to assess further specific objectives or to measure Massachusetts objectives not included as part of NAEP's testing.

The third statewide assessment was administered in January (to grade 12 students) and April (to grades 4 and 8 students) of 1990. The only students excluded from the MEAP tests were those exempt as special education or limited-English-proficient students, and those who were absent from school during testing and make-up sessions. Over 155,00 Massachusetts students took the tests, as the chart below illustrates.

	Grade 4	Grade 8	Grade 12
Enrollment	61,987	57,024	54,599
Students included in school reports	55,603	50,150	49,032
Number of limited English Proficient	954	531	542
Number of Special Education	4,770	3,917	2,442
Number eligible but not tested	246	586	432

The goal of the assessment—to provide school and district results, rather than scores for individual students—guides test development, administration, and reporting decisions.

Test Development

Test questions cover a broad range of student knowledge and abilities, from basic to higher order skills, in all the subjects assessed. MEAP tests consist of three components that measure not what is taught in any particular grade, but everything a student could be expected to learn up to that grade level, encompassing the entire range of student ability and providing a challenge for all students.

Test objectives were first reviewed by district and school personnel in Massachusetts when the original MEAP tests were developed and are revised and updated for each round of testing. These items come from previous MEAP tests, from NAEP tests, and from questions developed and field tested specifically for Massachusetts students. Approximately 80% of the test items are re-used to provide comparable results from year to year.

In addition to the multiple-choice questions traditionally used in educational assessments, the 1990 MEAP tests included several open-ended questions in each subject, designed to examine students' ability to apply knowledge and understanding in different contexts. Students are required to interpret and justify, as well as communicate, their knowledge in the different content areas. Between five and eight percent of the students, depending on grade level, completed an open-ended section of the test. Responses were scored by Massachusetts teachers, using standardized scoring guides developed each question. Full descriptions of the questions and discussion of results will be published in the coming year.

In addition to the subject area tests, all students, teachers, and principals at the appropriate grade levels complete questionnaires about their backgrounds, classroom practices, attitudes toward learning, and other factors that have been shown to relate to educational achievement. Highlights from the questionnaire responses are included in Chapter 2 of this report.

Test Administration

The MEAP tests are given in individual classrooms by local test administrators—classroom teachers, in most cases. To ensure uniform testing procedures, school personnel attend test administration workshops and are provided with manuals giving specific directions for all components of the testing program.

Because the program seeks only aggregate school and district scores, each student completed only a sample of test questions in each subject, requiring testing time of 90 minutes per student. Using a technique known as "matrix sampling," the total number of test questions in each subject area is divided into several forms per grade. Each student completes one form. This design produces valid and reliable test scores for the school and district as a whole. The total number of test questions, by grade and subject, is shown below.

Content Area	Number of Test Questions		
	Grade 4	Grade 8	Grade 12
Reading	175	231	293
Mathematics	230	301	390
Science	230	265	371
Social Studies	240	279	390
Total	**875**	**1,076**	**1,444**

Test Administration at Grade 4. All fourth grade students completed a practice test, a student questionnaire, and the four-session cognitive test. The practice test was designed to acquaint young students with the kinds of questions and procedures used in the tests so that they would be comfortable and be able to perform to their ability in actual test sessions. Students recorded their answers on a machine-scannable answer sheet.

Each of the four test sessions covered one subject—reading, mathematics, science, or social studies. At grade 4, there were twelve different forms of the test booklet with subjects arranged in different order, so that students in one classroom worked on different subjects during any one test session. In addition to the multiple-choice questions, approximately 8 percent of the fourth grade students answered several open-ended or short-answer questions during Session 4.

Test Administration at Grades 8 and 12. The upper level students in the MEAP testing program completed two student questionnaires (one common to all students, and one of several forms matrix-sampled among students) and the two-session cognitive test.

The test administration procedures for grades 8 and 12 were similar to those at grade 4. At grade 8, there were sixteen different forms of the test, and at grade 12 there were twenty different forms. Approximately five percent of the students in these two grades completed open-ended questions in each of the four subjects during the second test session.

Teacher and Principal Questionnaires. All fourth grade teachers completed one form of a teacher questionnaire exploring teachers' backgrounds and training, school practices and decision-making, and classroom activities. Eighth and twelfth grade teachers of language arts, mathematics, science, and social studies completed individual forms of the teacher questionnaire which contained, in addition to the more general material, questions directed toward the subject they teach. Fourth grade teachers and eighth grade teachers of mathematics, science, and social studies were also given sample open-ended questions from the tests and asked whether the knowledge or skill needed to answer the question was part of their curriculum.

Principals of schools with fourth, eighth, and twelfth grade students answered questions measuring schoolwide variables affecting education: experience and longevity of the teaching staff; curriculum development activities in the school and district; school programs in reading and writing; and problems facing their schools.

Reporting of Results

Data from the Massachusetts Educational Assessment Program will be released in a variety of ways during the 1990-91 school year. School and district reports, issued early in November, provide detailed information on student performance. Presented in relation to a Comparison Score Band that allows schools and districts to compare their scores with others with similar background characteristics, they include scores for each subject, broken down by subskills and objectives; questionnaire responses related to performance on the MEAP tests; distribution of students at different proficiency levels; open-ended question results, and other information. *Using the School Report*, delivered with school and district reports, explains how to use MEAP data to examine curriculum and facilitate curriculum development. In the future it is planned to expand the open-ended portion of the test and incorporate that information in the school scores.

A series of reports concerning student performance in open-ended sections of the assessment tests will be released during the coming year. Other publications of the program include *Description of the MEAP Proficiency Scales* which describes the typical attainment of students at each level. In addition, a report comparing the performance of Massachusetts students with national results will be provided when 1990 data are released by the National Assessment of Educational Progress.

CHAPTER 2: STUDENTS, TEACHERS, PRINCIPALS THEIR SCHOOLS—A DESCRIPTION

Student Questionnaires

By means of student questionnaires, all students who participated in the Massachusetts Educational Assessment provided some information about their backgrounds, activities both inside and outside the classroom, and attitudes toward school and learning. At grade 4, all students responded to a common questionnaire composed of 22 items; the material was read aloud to students, and teachers could assist in clarifying questions or answer choices if the students requested such help. At grades 8 and 12, students independently completed one common questionnaire for each grade level, and one of several different forms of a second questionnaire, totaling approximately 40 questions. Each form of the second questionnaire focused on a different subject tested in the assessment—reading, mathematics, science, or social studies. Data from the student questionnaires give some insight into student attitudes and factors that affect learning.

Data Used to Compute Comparison Score Bands. Several background questions asked in the questionnaires were used for interpretation of results and other analysis. Some of this information was combined with information provided by principals to construct the Comparison Score Bands used in the school and district reports of results.

Parental Education:

A question about parental education ("the highest level of school attended") was asked at grades 8 and 12. Patterns of response at both grades were similar and were virtually the same as responses given during the previous MEAP testing.

- Between 32-38 percent of parents completed high school.
- Approximately 42 percent of parents have some post-secondary education.

Home language:

Another factor used in the computation of Comparison Score Bands at grades 8 and 12 was the incidence of languages other than English spoken in the student's home. The question was also asked at grade 4, although it did not contribute to calculations for the Comparison Score Band.

- English is the only language spoken in the homes of about 70 percent of the students.
- Languages other than English are spoken "most of the time" in approximately 12 percent of the homes.

Book ownership:

A third factor examined in comparative scores for elementary students (but asked of students at all grades) concerned book ownership. Students were asked how many books of their own, excluding school books or comic books, they have at home.

- More than two thirds of the grade 4 students have 30 or more books of their own.
- Slightly more than half of the grade 8 students have 30 or more books of their own.
- Only one third of high school students have more than 30 books of their own.

Fourth grade students were also asked about their length of residence in the U.S. and attendance at a preschool program; the results of the responses to these questions were used in the development of the Comparison Score Bands. Information concerning free and reduced price lunches in the school, and the Kind of Community, determined by means other than the student questionnaires, was also used in the computation of the score bands.

Activity Outside the School. Students at all grade levels were asked about activities they pursue on their own time, focusing on three primary pursuits—time spent reading for pleasure, watching television, and doing homework. In addition, high school students were asked about time devoted to paying jobs.

Reading for pleasure:

- More than half of grade 4 students read for pleasure on a daily basis.
- By grade 12, less than 30 percent of the students report that they read for pleasure on a daily basis.

As might be expected, those students who read frequently and for longer periods of time show higher scores across the curriculum on the assessment.

Television viewing:

- Forty percent of grade 4 students watch 2-3 hours of television each day and 35 percent of them watch television for more than 4 hours each day.
- More than half of grade 8 students watch television for 2-3 hours daily and more than 29 percent report watching television for more than 4 hours per day.
- Slightly less than half of grade 12 students watch 2-3 hours of television daily and 13 percent watch more than 4 hours per day.

Moderate amounts of television viewing seem to have little impact on test scores. Those students who watch television more than four hours per day and those who report that they do not watch television had significantly lower test scores.

Part-time employment:

- Nearly one fourth of grade 12 students work at a paying job more than 21 hours each week while an additional 41 percent work between 11 and 20 hours a week.

Students who work ten or fewer hours per week at a paying job had higher scores on the assessment than those who did not have part-time employment and those who work 11 hours or more. As the time devoted to part-time work increases to more than 11 hours per week, there is a corresponding drop in student scores across the curriculum.

Homework:

- Eighty-seven percent of grade 4 students spend less than 1 hour per day on homework while the remaining 13 percent spend more than one hour.

- Nearly three fourths of grade 8 students spend one hour or less per day doing homework while the remaining quarter spend 2 or more hours per day doing homework.

- More than half of grade 12 students spend one hour or less on homework each day; 36 percent of them spend 1-3 hours per day and only 4 percent spend more than 3 hours on homework each day.

Grade 4 students who report spending more than one hour per day on homework have lower scores than those students who spend less time. However, at the two upper grades, those students who spend increasing amounts of time on homework have correspondingly better scores on all MEAP tests.

Attitudes toward School and Learning. Students at all grades were asked a variety of questions about their attendance and feelings toward school. In addition, they were asked questions pertaining to different content areas in the curriculum, their perceptions about learning in specific subjects, the degree of difficulty in both subject content and text books, and the importance of memorization in particular subjects.

School attendance:

- Nearly two thirds of grade 4 students report that they like going to school "all" or "most of the time" while only 10 percent "never" or "hardly ever" like school.

- Eighty-two percent of grade 8 students report missing two or fewer days of school in the four weeks preceding the testing and 11 percent missed three or four days of school during the same period.

- In both grades 8 and 12, seven percent of the students were absent for five or more days during the four weeks prior to the testing period.

At grade 4 those students who liked going to school scored higher in the testing than those who reported that they did not like to going to school. At the other grade levels, there was a relationship between increased absenteeism and decreased scores in all content areas.

Mathematics, Grade 4:

- In grade 4, 54 percent consider mathematics their "favorite" or "one of their favorite subjects". One third of the students "like other subjects better" and the remainder called mathematics their "least favorite subject". There was very little difference in the scores between those students who like mathematics and those who do not.

Mathematics, Grade 8:

- Slightly more than one quarter of grade 8 students are "very interested" in mathematics and about half of the students are "somewhat interested".

- Forty-six percent of these grade 8 students find mathematics to be "very" or "moderately" difficult.

- Learning mathematics is considered to be mostly memorization by 59 percent of grade 8 students; 25 percent of the students do not feel that memorization is a large part of learning mathematics.

- Despite their perception of the difficulty of mathematics and the importance of memorization, eleven percent of the grade 8 students report that they do no mathematics homework each week. Twenty-three percent spend more than 2 hours per week on mathematics homework.

Mathematics, Grade 12:

- Interest in mathematics declines by the time students are in grade 12; one fifth are "very interested" in mathematics and only 45 percent are "somewhat interested". More than one third of the students in grade 12 report "not much" interest in mathematics.

- Grade 12 students find mathematics to be more difficult than the grade 8 students. Sixty-one percent report math to be "moderately" to "very difficult".

- The perception of the importance of memorization decreases for grade 12 students; 48 percent report that mathematics is mostly memorization and 32 percent feel that memorization is not a large part of learning mathematics.

- Seventeen percent of the grade 12 students report that they spend no time each week on mathematics homework, while 25 percent spend more than 2 hours per week doing mathematics homework.

Students in grades 8 and 12 who are interested in mathematics and spend more time on homework score higher than students who are less interested and/or spend less time studying. Students who believe that memorization is an important part of mathematics have significantly lower scores than those who do not feel that mathematics involves mostly memorization.

Science, Grade 4:

- Fifty-four percent of grade 4 students consider science one of their "favorite" subjects; the remaining 46 percent reported it is their "least favorite" or that they "like other subjects better".

Science, Grades 8 & 12:

- In grade 8, 81 percent of the students are "very" or "somewhat" interested in science and 47 percent consider it "moderately" to "very difficult". Grade 12 students are less interested in science than grade 8 students, with 67 percent reporting that they are "very" or "somewhat" interested. Two thirds of grade 12 students consider science to be "moderately" or "very" difficult.

- Nearly half of the students in these two grades believe that memorization is an important part of learning science while approximately 30 percent think it is not important.

- In both grades 8 and 12, slightly more than half of the students spend less than 1 hour per week on science homework; this includes approximately 11 percent who report that no homework is assigned.

- Only 10 percent of grade 8 students spend more than 2 hours each week doing science homework. However, 20 percent of grade 12 students spend more than 2 hours per week on homework in their science subjects.

Writing:

- In both grades 8 and 12, approximately 11 percent of the students report that they wrote no reports, papers, or compositions in any of their subjects during the four weeks preceding the testing.

- Approximately 15 percent of students in grades 8 and 12 were required to write more than five compositions in their subjects during that 4 week period.

Those students who are required to write more papers have higher scores across the curriculum than those who do little or no writing.

Family involvement:

Students report less discussion of their school activities with family as they get further along in school.

- Approximately sixty percent of fourth and eighth grade students talk daily with someone in their family about their school work. By grade 8 there is a slight increase, from 11 percent to 15 percent, in the number of students who report that they "never" or "hardly" ever talk with family about school.

- Only 44 percent of grade 12 students talk with someone in the family about school work on a daily basis; nearly 20 percent report that they never or hardly ever discuss their school work at home.

Those students who discuss their school work with family achieve consistently higher scores on the assessment than those who "never" or "hardly ever" share their school activities with someone at home.

Teacher Questionnaires

Teachers of fourth, eighth, and twelfth grade students completed questionnaires asking about their professional backgrounds and experience, classroom and school responsibilities, and their perceptions about their students. All fourth grade teachers completed the same form of the questionnaire; eighth and twelfth grade teachers responded to different forms according to subject area—mathematics, science, social studies, or language arts.

Years teaching:

- Ten percent of fourth grade teachers have taught for four years or less; 39 percent have spent more than 20 years as classroom teachers.

- At grade 8, 7 percent of the teachers have been teaching for 4 years or less; 38 percent have taught for 20 years or more.

- Grade 12 teachers who have taught 4 years or less comprise 6 percent of the teachers at that level; 46 percent have taught 20 years or more.

These figures illustrate that the teacher force is aging, with few people entering the teaching field. As older teachers retire, there is a potential for problems caused by a dwindling supply of teachers.

Available resources:

Teachers at all levels were asked to respond to questions about the resources available to them. At grade 4 these were general questions relating to classroom resources; at grades 8 and 12 science teachers were asked about available science equipment and its condition.

Grade 4:

- Only 8 percent of the grade 4 teachers report that they get all of the resources they need. Forty-one percent get most of what they need and 39 percent get some of the materials that they need. Eleven percent report receiving few or none of the resources they need in their classrooms.

- A children's book collection and maps, charts, and globes are available in 96 percent of the grade 4 classrooms. Approximately two thirds of grade 4 teachers report that they have plants or animals, computers, primary source material, and manipulatives for number work available.

Grade 8:

- Only 5 percent of grade 8 science teachers report that their students have individual equipment to use. Forty-one percent of the students share with another student and 36 percent must share equipment in groups. Fifteen percent of the teachers report that they have little or no science equipment.

- Forty-four percent of grade 8 teachers say that their science equipment is in good condition; approximately one third say that their equipment is in fair condition, while 9 percent report that their equipment is in poor condition.

Grade 12:

- At grade 12, 10 percent of the students have individual science equipment. More than half share equipment with one other student, and nearly one third must share equipment within a group. Six percent of the teachers report having little or no science equipment for their students.

- Approximately half of the grade 12 teachers report that their science equipment is in good condition. Slightly over one third say that their equipment is in fair condition, while 8 percent report that their equipment is in poor condition.

Homework:

Teachers at grades 8 and 12 were asked to estimate how many hours per week in each subject area the typical student would need to complete assigned homework. Averages across the curriculum are shown in the following chart.

	Grade 8	Grade 12
Homework not usually assigned	6%	4%
Less than 1 hour	15%	10%
1-2 hours	37%	27%
2-4 hours	33%	44%
More than 4 hours	9%	15%

Student attitudes:

Grade 8 and grade 12 teachers were asked to give reasons for students not making satisfactory progress in school, indicating the importance of the different factors. Averages for several of the options are shown below.

Grade 8	very important	somewhat important	not important
student indifference/ lack of motivation	68%	26%	6%

poor preparation prior to entering class	45%	37%	18%
too many outside demands on student time	15%	44%	41%
student absenteeism	33%	44%	29%

Grade 12	very important	somewhat important	not important
student indifference/ lack of motivation	64%	28%	8%
poor preparation prior to entering class	43%	40%	17%
too many outside demands on student time	30%	47%	23%
student absenteeism	42%	34%	24%

Principal Questionnaires

All principals of schools housing fourth, eighth, or twelfth grade students were asked to complete a questionnaire addressing school policy and practices. The questionnaires reveal how diverse factors affect the schools and provide background, context, or contrast to information gleaned from student and teacher questionnaires.

Principal characteristics:

- Two thirds of the principals at the elementary level are male; approximately 85 percent of principals in middle schools and high schools are male.

- The years spent as principal in their current schools is similar at all three levels.

Years	Percent Grade 4	Percent Grade 8	Percent Grade 12
1	14	13	10
2-4	27	29	25
5-9	18	24	31
10-20	27	22	29
Over 20 years	13	12	5

School resources:

Principals at all schools were asked questions relating to their curriculum and the resources available to students and teachers.

- At the elementary level, more than half of the principals reported that the school district was responsible for decisions regarding the selection of core materials; a little

more than 25 percent of the schools have a group of teachers responsible for these decisions.

- These figures were reversed at the middle school level; in just over 50 percent of the schools core instructional materials are chosen by teachers and in 26 percent of the schools the decisions are the responsibility of the district.

- Library acquisitions for last year were reported for schools at all levels.

Books	Percent Grade 4	Percent Grade 8	Percent Grade 12
No response	1	2	5
0-99	34	24	14
100-199	31	31	25
200-299	19	25	17
300-499	9	18	21
More than 500	6	—	18

Instruction:

- Seventy-six percent of elementary school principals report that more than 4 hours per week for instruction is required in reading and in 55 percent of the schools more than 4 hours of mathematics instruction is required each week. Approximately 5 percent of schools require more than 4 hours per week for instruction in science and social studies.

- At the middle school level, more than 4 hours per week devoted to reading instruction is required at slightly over one quarter of the schools. About 38 percent of all middle schools require more than 4 hours per week in mathematics, science, and social studies.

- Thirty-one percent of the high schools plan to increase their course offerings in science within the next two years.

Science equipment budgets:

- More than half of the elementary schools have a budget of less than $250 to spend on new science equipment annually.

- Twenty percent of middle schools have an annual budget for new science equipment that is less than $250.

- More than $600 for the purchase of new science equipment is budgeted annually at 68 percent of the high schools, yet 12 percent of the high schools have an annual budget of less than $100 for new equipment.

Those schools with higher budgets for replacement of science equipment had higher student scores. However, students in those grade 8 schools reporting budgets of more than $1000 for science equipment actually have slightly lower science scores.

Parent/school involvement:

All principals responded to questions regarding practices involving parents in their schools.

- About 85 percent of elementary schools and about 90 percent of middle schools and high schools notify parents after 2-3 unexcused absences of their children.

- Parents are informed of low grades half way through the grading period by 88 percent of the elementary schools and virtually all of the middle and high schools.

- Personal contact with parents decreases as students move to higher levels in the schools. At the elementary level 64 percent of the principals report that conferences are held at least once a semester. In the middle schools only 46 percent of the principals report that parent/teacher conferences are held at least once a semester; in the high schools this percentage drops to 39.

Problems in the schools:

Both high school and middle school principals report little change from the previous MEAP administration regarding problems within the schools. At the elementary level, there was the perception that problems regarding physical conflicts among students, vandalism of school property, and verbal abuse of teachers have become slightly more serious than at the time of the 1988 MEAP testing.

CHAPTER 3: ASSESSMENT RESULTS

As noted in the Introduction, there are two components of the tests which students receive. One, the multiple-choice portion, clearly carries the burden of the testing. All students receive multiple-choice questions in the four subject areas and their responses are combined to produce the school and district scores. The second component, the open-ended questions, are answered by only a sample of the students and the results do not contribute to the subject area scores.

Section A: Multiple-Choice Questions

In order to maintain the continuity of the program, approximately 80 percent of the multiple-choice questions were repeated from the 1988 assessment. This policy allowed for a direct comparison of results between the two assessments. Relative declines or improvements in performance can be noted, both at the subject area level and in regard to the more finely delineated categories and subcategories within each subject.

Throughout the state as a whole, performance showed a marginal improvement (a shift of 10 points in the state average) in all subject areas for students at the fourth and eighth grade levels. Twelfth grade scores showed no change in any of the subjects tested. Larger shifts of up to 20 points occurred within subject area categories and shifts of twice that magnitude occurred in a few of the subcategories. Because such shifts in average scores are highly influenced by the size of the sample on which they are based, it is not surprising that state-wide averages show little change. This is not the case with individual schools or, even districts, where the scores represent far fewer responses. In general, however, general trends are more indicative of change than the magnitude of the differences between years. The results of the 1990 assessment show a positive trend in achievement for the younger grades. If this continues in the 1992 assessment we will be more confident in our judgments of progress.

Because of the relatively small change in student responses to the multiple-choice questions, there is little new to add to our discussion of results that appeared in the *1988 Statewide Summary*. Consequently, in this report, we will concentrate our attention on student responses to the open-ended questions.

Section B: Open-ended Questions

The purpose of including open-ended questions in the assessment is to validate the scores derived from the multiple-choice questions and to provide a more accurate and well-rounded picture of what students know and how they apply that knowledge. Between five and eight percent of the students, depending on the grade level, completed an open-ended section of the test. Responses were scored by Massachusetts teachers, using standardized scoring guides developed for each question.
Open-ended questions were administered in order to provide a more accurate and well-rounded picture of what students know and how they apply that knowledge. The open-ended questions (essay and short answer) attempt to mine a larger realm of student skills than the multiple-choice questions. They are not a means of supplanting the information given by the multiple-choice, but a means of enhancing it. We sampled students at each grade level (one twelfth at grade four; one sixteenth at

grade eight; one twentieth at grade twelve). Each student tested was given a booklet that contained either math and reading questions or science and social studies questions. These questions ranged from higher order thinking questions to process skills and knowledge questions. The discussion in this chapter refers only to the open-ended questions that are reported in the school and district reports. A more complete description, along with the scoring guides and examples, will be available in separate publications, to be published in 1991.

Reading

Grades 4 & 8

The reading questions focussed on various critical thinking skills and reading strategies. At grade four, students were asked questions ranging from interpreting a poem to understanding and evaluating advertising techniques. In a twist on the usual reading questions, students were asked to create a business card with the appropriate information. Perhaps one of the most interesting questions was given at both grades four and eight. Students were asked to read a few sentences from an extremely short story. They then were asked questions which examined various aspects of reading from prior knowledge to reading strategies.

The stillness of the morning air was broken. We headed down the bay. **What are some questions you would want answered so that you would understand what this story is about?**

Here we examine the frames of reference that students bring to a piece even before they start to read it. Reading is not a process in which knowledge is imparted from the text to the reader, but an active relationship in which the reader synthesizes what the text says in relation to what the reader already knows. We expected the questions to reflect some experience with the narrative genre, i.e., Who is heading down the bay? (character); Why are they heading down the bay? (plot); Where is the bay? (setting); Who is the narrator? These types of questions indicate familiarity with the genre. These are the kinds of questions that "set the scene" for reading, that is, the student recalls similar pieces and what happened in those pieces. Forty percent of the fourth grade students and sixty-eight percent of the eighth graders were able to ask at least two questions that reflected an understanding of narratives. Another fifteen percent of the fourth graders and the eighth graders asked one question that reflected an understanding of the genre.

The net was hard to pull. The heavy sea and strong tide made it even more difficult for the girdie. The good catch encouraged us to try harder. **What do you think is going on in this story? Why do you think so?**

This question required that students shift from the external mode of questions about the genre to an internal analysis of the text. Students made inferences based on context clues about the action. We weren't looking for the simple response of "fishing", which we could have learned from a multiple-choice question, but we wanted to learn how students arrived at that conclusion. Although fishing is not explicitly mentioned, there is considerable evidence to identify it. Students were able to describe the action accurately despite the unusual language (e.g. "girdie") and the ambiguity of the text. Other answers could have been acceptable, such as "They were in a storm," because of the heavy sea and strong tide or "They were working very hard" based on the idea of a good catch along with the sea conditions. Three-fourths of the fourth graders and eighty percent of the eighth

graders were able to generate acceptable answers and cite the appropriate evidence. Another fourteen percent of the fourth graders and sixteen percent of the eighth graders answered "fishing" without citing the clues. Very few students were confused by the unknown term "girdie."

Grade 12

Students at grade twelve also were given questions that measured internal and external analyses. External analysis requires students to call upon their prior knowledge and make decisions about the reading process, while internal analysis uses evidence from the text to arrive at conclusions about what the text means. Students were asked to read a passage from the novel *Deliverance* and then draw conclusions about one of the characters mentioned in the passage. Again, we asked that students present the evidence that led them to their conclusions. Since the passage contained no outright descriptions of Lewis, assumptions had to be made based on what the character said, what the character did, and what others said about the character. Another challenge to students was that there were four characters including the narrator in the passage. Evidence had to be selected and evaluated appropriately. Also assumptions had to be made about actions, i.e., that a certain type of action befits a certain type of character. Sixteen percent of the students were able to answer in a way that effectively captured and justified several traits or provided an in-depth discussion of one of those traits. Thirty percent of the students were not able to answer even in a minimally correct manner.

Another grade twelve question examined the external processes of reading.

Read the title and the first three paragraphs of the recent newspaper article shown below. Describe the kind(s) of information you think the rest of the article will contain.

Here students had to call upon their experience with different types of texts to predict the kinds of information that the rest of the article will contain. The best answer did not contain specific facts that the article might give, instead it gave the kinds of information one would find in a newspaper. Only four percent were able to answer this question in the most satisfactory manner, that is, describing a type of information rather than the content itself.

External response

> *The author's description of what he might think, some other opinions, maps of the area, maybe a discussion with some people from the rain forest and others from Greenpeace, an outline of what the government is doing about this.*

Internal response

> *The kinds of information the rest of the article will include are: how the fires affect global warming, what is global warming, how to stop global warming and these fires.*

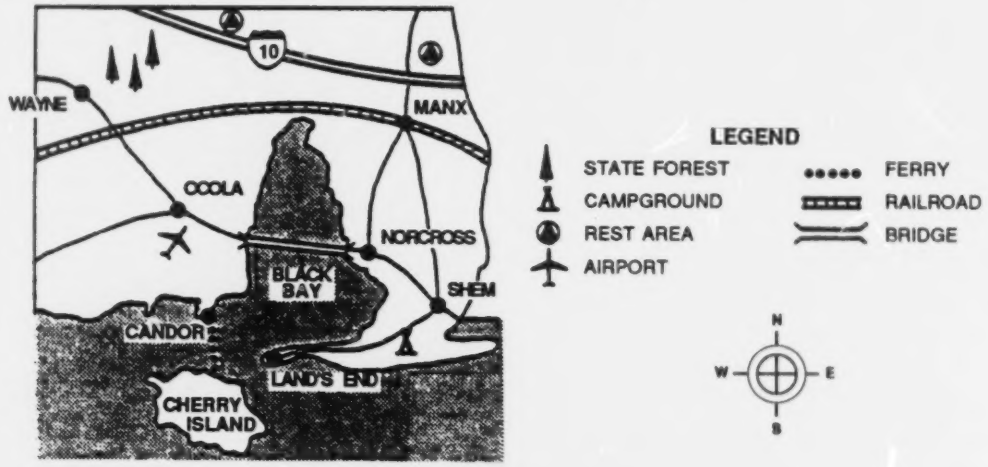
Note that in the second answer, the kinds of information are merely different types of content rather than different types of information, but the first response lists opinions, descriptions, a graphic presentation, and an outline.

Social Studies

Grade 4

At grade four, questions ranged from economics (how to best improve the sales of a lemonade stand), to map-reading, to a sense of history (compare and contrast Colonial America to contemporary America).

Students were presented with a map and asked the following question.



You and your family live on Cherry Island. (See map above.) Some friends are coming for a visit. They will be traveling east on Route 10. Write a set of directions telling your friends how to get to Cherry Island.

This question required analytical skills along with map reading skills in order to give a clear and accurate route. About one fourth of the students gave absolutely accurate routes using either cardinal directions or left/right directions, with another fourth presenting fairly accurate routes with minor inaccuracies. Many students gave directions which included inaccessible routes or modes of transportation other than automobile. That just over half the students were able to successfully complete this exercise suggests that students are not exposed to this type of question. They may be accustomed to tracing a route on the map, or locating spots on the map, but they experience difficulty when attempting to translate the visual into a written set of directions.

Two questions attempted to reveal fourth graders' sense of history by asking them to compare the lives of school age children in colonial America to the lives of contemporary children. Students were given a picture of a colonial classroom and asked to "discuss the many ways that they were the same and different." The most complete answer dealt with human similarities rather than details of technology. For example, "They learned neat things in school and enjoyed playing when they were done. They liked being with their families and when they were bad they probably were yelled at." This student recognizes certain universalities of human nature. In dealing with differences, clearly technology and how it affects our lives was a key element to a satisfactory answer. The following response typifies a student who discussed, rather than listed, the differences.

They had to work a lot harder than us and they had to make all of their entertainment. They did not have as many varieties of entertainment such as radios, televisions, movies and video-games. They had to use toys that weren't very well made and they didn't have a lot of them. They did not have much transportation so they had to stay at home a lot and most of their clothing was handmade.

Most of the students resorted to listing the similarities (62%) and differences (68%) with no real comparison. Many students used the picture as their guideline and did not mention anything except similarities and differences that were portrayed in the picture.

Grade 8

At grade 8, the questions ranged from interpreting a political cartoon, to using a timeline, to evaluating the strengths and weaknesses of different arguments.

Students were given a political cartoon about the Alaskan Oil Spill and Exxon's inadequate response to the spill. Here students had to use their knowledge of contemporary affairs as well as their interpretive skills. They had to make the leap from the humorous graphic representation to the actual point of the cartoon. Just over one third of the students were able to correctly identify the main idea with an accurate and well-developed response. Another quarter were able to give a reasonable response but lacked development. The rest were not able to answer with any degree of satisfaction. Many students understood the general idea but couldn't synthesize the event with the cartoon representation in order to understand the point of the satire.

The cartoon at the right is making fun of Exxon and the way they took the Alaskan Oil spill lightly. The artist is trying to show that despite everything the company said, Exxon was unprepared for this disaster.

Compare this response to the following:

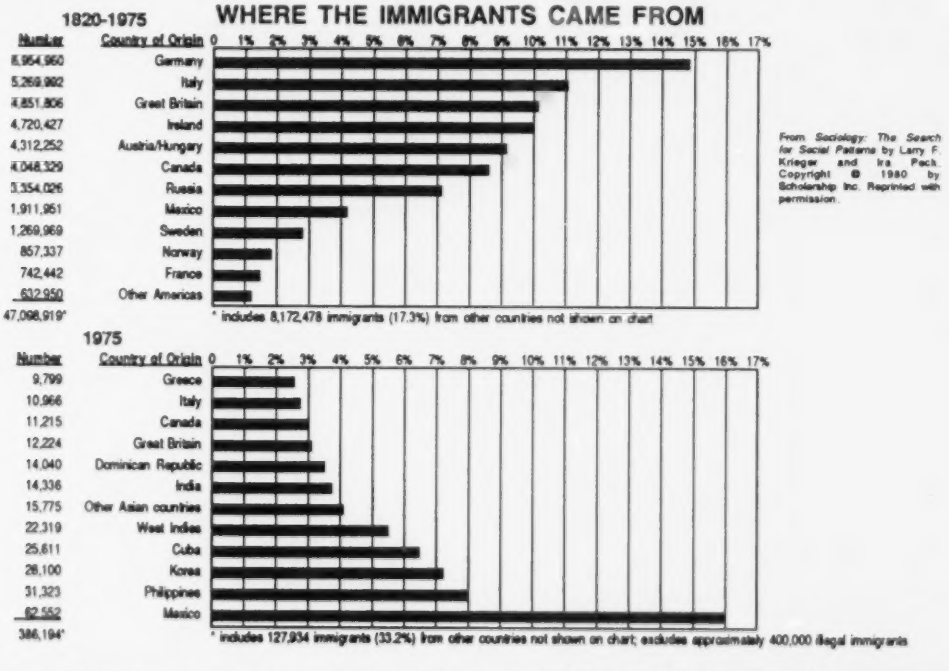
I think the cartoon is making fun of the captain of the Exxon Valdez. The main idea for the cartoon is that they would possible be able to clean it up with the maid and their mops, they would just mop the shores clean. But it's not that simple.

This student hovers around the edge of correctness, yet does not quite grasp the idea that the figures in the cartoon are representations of larger issues. The student cannot make the leap from literal to figurative.

Another eighth grade question dealt with students' ability to resolve a problem and to look at the possible negative ramifications of their resolution. The situation presented involved the problem of the discovery in a town dump of hazardous wastes produced by a large manufacturing plant in the town. Students were asked to suggest three courses of action and their negative impacts. At least half the eighth graders were able to generate appropriate responses to this question, with thirty-four percent giving well-developed responses in which they recognized the complexity of the problem and the need to consider more than one side of an issue. Although many students are very concerned with environmental issues, they considered the economic realities of the day. Though the plant may be creating hazardous wastes, it may be the principle source of revenue for the town and its economic impact has to be considered. Many students took the long view and considered the negative impacts for future generations. For example, if the waste is buried "the problem of the waste hasn't gone away and will have to be dealt with eventually." Less than thirty percent of the students were unable to offer even minimally correct responses to this question.

Grade 12

At grade twelve the questions ranged from interpreting data from a graph and using that data to draw conclusions to discussing the impact of policies on the social, political, and economic climate in the United States.


1820-1975
WHERE THE IMMIGRANTS CAME FROM
Number
Country of Origin
0 1% 2% 3% 4% 5% 6% 7% 8% 9% 10% 11% 12% 13% 14% 15% 16% 17%
6,954,960 Germany
5,269,992 Italy
4,851,806 Great Britain
4,720,427 Ireland
4,312,252 Austria/Hungary
4,048,329 Canada
3,354,026 Russia
1,911,951 Mexico
1,269,969 Sweden
857,337 Norway
742,442 France
632,950 Other Americas
47,098,919*
* includes 8,172,478 immigrants (17.3%) from other countries not shown on chart
From Sociology: The Search for Social Patterns by Larry F. Kriegar and Ira Peck. Copyright © 1980 by Scholarship Inc. Reprinted with permission.
1975
Number
Country of Origin
0 1% 2% 3% 4% 5% 6% 7% 8% 9% 10% 11% 12% 13% 14% 15% 16% 17%
9,799 Greece
10,966 Italy
11,215 Canada
12,224 Great Britain
14,040 Dominican Republic
14,336 India
15,775 Other Asian countries
22,319 West Indies
25,611 Cuba
28,100 Korea
31,323 Philippines
82,552 Mexico
386,194*
* includes 127,934 immigrants (33.2%) from other countries not shown on chart; excludes approximately 400,000 illegal immigrants

Students were given two graphs: one spanned the years 1820 to 1975 and listed the percentages of immigrants from their countries of origin; the other presented the same information for the year 1975. Students were asked two questions.

The numbers of immigrants are given to the left of each graph. Why are there more immigrants listed on the top graph than on the bottom one?

What changes in the U.S. immigration patterns do the graphs show?

The first question was given to direct students to the proper reading of the graph. The answer was simply that the top graph spans 155 years and the bottom graph is only one year. Thirty-five percent of the twelfth graders answered this correctly. Many of the incorrect responses suggested that in 1975 there were quotas on immigration thus the numbers are smaller.

More students answered the interpretive graph question correctly. In response to what changes in the U.S. immigration patterns do the graphs show, just over half (51%) the twelfth graders were able to answer satisfactorily. Here students noted that immigration had shifted from European nations to Asian and Latin American countries. Those who answered correctly were able to generalize and draw conclusions from the graph. Those who answered incorrectly often stated that immigration had decreased and quoted numbers from the graphs.

Science

Grade 4

At grade four, students were asked questions about life science and physical science. They were asked to relate form to function in birds as well as to describe the importance of plants to humans. They also were asked to test a hypothesis and produce a physical model of a scientific phenomenon. The physical science questions dealt with evaporation and erosion.

Every time Tom boils water to make spaghetti, the insides of his kitchen windows get wet. Explain how this happens.

Just over half of the fourth graders were able to at least discuss the process of evaporation. Another fourth were able to discuss both evaporation and condensation with some accuracy. This is a straightforward knowledge question suggesting that students have been exposed to the idea of the different physical states of water.

Children were able to discuss the production of steam fairly coherently, yet they faltered when trying to discuss its condensation back to water. Often students knew the terms evaporation and condensation, but were not able to elaborate.

Another physical science question considered geology. Students were given a picture of the Grand Canyon and asked:

People claim the canyon shown above was created by water. Explain how water could do this.

Although almost sixty percent of the fourth graders were able to answer this question correctly, only sixteen percent were able to give a detailed description of erosion that included water moving over land for a very long period of time. Many students were able to discuss the moving water, but did not recognize the effect of time. As in the previous question, many students answered erosion with

no elaboration. Like evaporation and condensation, the term was familiar to them, but they could not define it. This "buzzword response" argues for a continued use of open-ended tests which require students to explain their responses.

Exposure to the process of erosion is the key to responding satisfactorily. Students' incorrect answers were extremely diverse, with equal numbers answering "the rain washed away the rock" as the "water flowed through and left the rocks," or "there had been a flood and it left the canyon," or citing some natural phenomenon, such as an earthquake created the canyon.

Grade 8

At grade eight students were asked to use concepts in life and physical sciences as well as process skills, such as generating an experiment to prove a hypothesis or ordering information in order to draw a conclusion.

Students were given pictures of four birds (owl, woodpecker, robin, and heron) and asked to relate a characteristic of each bird to its food or habitat.

This task proved difficult for the majority of students. Most of them (39%) gave factual information about the bird without answering the question. For example, "the bird is an owl and owls live in trees. I know because we have one in our backyard." It appeared that students would rather be right in their own minds than speculate on something they aren't sure of. Often when students did answer correctly, it was evident that they used their prior knowledge of the bird's behavior rather than considering the characteristic and drawing a conclusion based on that characteristic. Fourteen percent related characteristics to both habitat and food. Another thirty percent could discuss one or the other correctly.

Grades 8 & 12

Among the physical science questions, students were asked: **Explain why the moon does not fall to earth.** Without a basic understanding of the opposing forces of inertia and centrifugal force students would not be able to successfully respond to the question. Only six percent of the eighth graders could respond correctly. By far the largest category of responses was that "gravity keeps the moon in space." This is not the notion of gravity as inertia, which would be partially correct, but rather the simple yet contradictory answer of gravity holding it up. There seems to be no contradiction in the minds of students that gravity, which keeps things earthbound, also keeps the moon from falling to earth. Again, it appears that students have been exposed to the idea of the opposing forces but only remember that gravity is one of them. When forced to elaborate they are unable to do so.

This question was also given to grade twelve students. They answered slightly better than the eighth graders with fifteen percent discussing two opposing forces correctly. Again, as in grade eight, the category with the largest number of responses was "Gravity holds it up."

Grade 12

Other grade twelve questions ranged from generating and interpreting graphs to devising studies to

prove hypotheses. In one such question students were given the scenario that a number of white perch were found dead along the shore of the Quabbin Reservoir. They were asked to generate two hypotheses and to describe how each hypothesis might be tested. This question examined two aspects of scientific inquiry: formulating a hypothesis and using controls in the test of that hypothesis. At least eighty percent of the students were able to generate reasonable hypotheses but only a quarter of those responding used controls when they described how to test their hypotheses. Half of the students used logical reasoning, i.e., the test was appropriate for the hypothesis, but lacked the controls to make it a true study. In previous years, we have found that students recognize the need for controls in a multiple-choice situation (1988 Assessment), but when students are asked to use the concept in an experiment, this knowledge is not applied.

Mathematics

Grade 4

The grade four mathematics questions often asked students to explain their results. Many questions involved more writing than computation; some asked students to generate a word problem that could be solved by a given computation, others asked students to explain why one graph is more appropriate than others for a set of circumstances. Spatial skills were considered when students had to evaluate geometric figures for similarities. Students were also asked to draw conclusions using information from graphs.

Students were asked to consider fractional parts in the following problem.

Mary, Paula and George want to share to candy bars equally. Show in the drawing below how much candy each person gets.

Sixty percent of the students could divide the candy equally using a variety of methods. Some divided each candy bar into three equal parts and labelled those parts with the initials of Mary, Paula, and George. Others divided one bar into two pieces, one third and two thirds; yet others divided both bars into halves, and then proceeded to divide one of those halves into thirds. Almost a quarter of the students left this question blank. Although sixty percent divided the bars correctly, only forty-five percent could write the correct fraction for the amount of candy each person received.

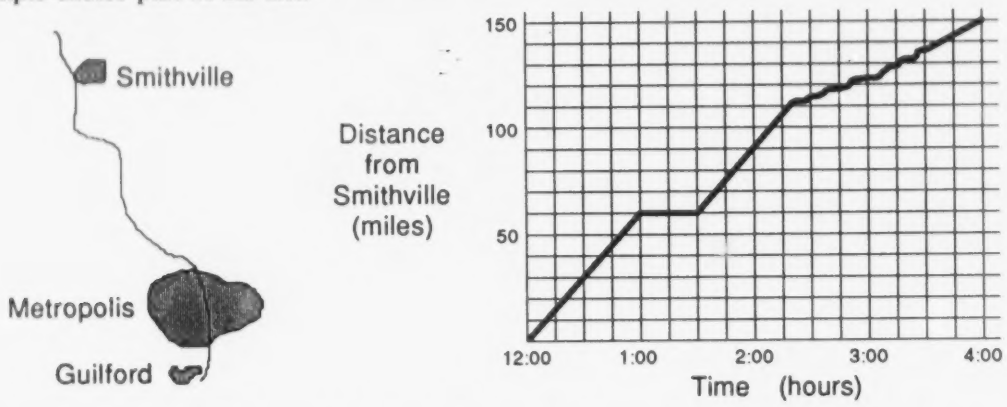
Another question that involved spatial visualization was:

Josh says that a 4-sided figure with opposite sides parallel must be a square. Draw a figure that proves Josh wrong.

This question investigated students' ability to use counter-examples as a means of proof. Sixty-seven percent of the students were able to generate an example that proved Josh wrong. Incorrect responses ranged from squares to four-sided figures with sides not parallel and some rectangular solids. These incorrect responses suggest that students may not have recognized the word "parallel".

Grade 8

At grade eight, the mathematics problems fell into three categories: use and interpretation of graphs; application and analysis of algorithms; and open-ended versions of word problems that appeared in the multiple-choice part of the test.



Students were presented with a map and a graph showing time and distance. They were asked to use them to describe the journey that they represented. More than half the students were able to draw at least one good inference from the materials supplied. Fourteen percent of the students answered by giving only accurate facts about the travellers, such as "They travelled sixty miles in an hour." Ten percent of the students attributed characteristics of the graph to the trip, such as interpreting the slope of the graph as indicative of a straight road.

Grades 8 & 12

The next question was given to both eighth and twelfth graders.

On John's tenth birthday, John's grandfather gave him $10. He gave John $20 on his eleventh birthday and $40 on John's twelfth birthday. Following this pattern, John's grandfather plans to give him $70 on his thirteenth birthday, but John expects $80. John's sister says that both amounts could be correct. Who is right? Explain.

There are two patterns here. John figures that his grandfather is doubling the amount he gives John each year. His grandfather is using his previous year's gift as a base and then increasing his gift by ten dollars each year. When John turns thirteen, his grandfather will start with a base number of $40 (John's twelfth birthday present) and add $30 to it ($10 for each year past age 10). Almost one fourth (24%) of the eighth graders and nearly one half (45%) of the twelfth graders recognized both patterns and were able to explain why John's sister was correct. Thirty-five percent of the eighth graders and six percent of the twelfth graders recognized one pattern and explained why John was right. Sixteen percent of the eighth graders and six percent of the twelfth graders answered that John's grandfather was right. One fourth of the eighth graders and twenty percent of the seniors were unable to recognize any pattern. At both grades, a small percentage of the students answered that the grandfather can do anything he wants with his money.

Grade 12

Grade twelve mathematics also examined students' understanding of area and average, along with the application of statistical techniques and the use of estimation.

The following question gives a definition of factorial and asks students to apply that definition to a problem.

The symbol n! (usually called "n factorial") is used to stand for the result of multiplying together the first n whole numbers so that for example,

10! = 1 X 2 X 3 X 4 X 5 X 6 X 7 X 8 X 9 X 10.

What is the value of 5!

Although the definition explains how to find the value of a factorial, it does not compute the multiplications. Half the students answered by multiplying the factors of five together and arriving 4 X 5. Although the question asked for the value, and the definition noted that ! stood for the result of multiplying together, half the twelfth graders taking the test did not read the example and question clearly enough.

In addition to the tasks that students received, teachers at the various grade levels were asked to indicate the extent that their students were prepared to answer these questions. Over the questions as a whole, approximately 85 to 90 percent of teachers at all grade levels reported that their students were either "well prepared" or "somewhat prepared" to respond to these tasks. However, there were some exceptions, particularly in the area of mathematics. A quarter of eighth and twelfth grade mathematics teachers indicated that their students were "not prepared" to answer the mathematics questions given at those grades. Over 30 percent of the fourth grade teachers also responded negatively to the question that asked students to supply an example of a four-sided figure that was not a rectangle. In addition, 20 percent of eighth grade teachers believed that their students were "not at all prepared" to explain why the moon does not drop to earth, while 35 percent believed that the critical discussion of the hazardous waste problem was inappropriate for their students.

CHAPTER 4: THE MEAP PROFICIENCY SCALES

The major purpose of the Massachusetts Educational Assessment Program is to compare academic achievement among schools and districts and to give curriculum and instructional guidance. Although the program obtains its information by testing students, its tests are not designed to give individual student results.

The scores which are most appropriate for this type of assessment are called scaled scores. These scores, in which the percentages of correct responses are statistically modified to conform to some common metric, were developed in order to make valid and accurate comparisons among schools and districts across the state and over time. When used in the school and district reports, they provide a measure of each school's achievement relative to that of every other school in the state. However, these scaled scores have no inherent meaning in themselves and they can even foster misinterpretation.

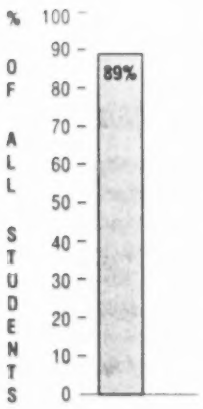
Because scaled scores were designed for comparison purposes only, they give no information about what students can actually do. For example, relative to the state as a whole, a school may receive a high score in chemistry even though its students answer few of the chemistry questions correctly. Although these students may be **perceived** to perform well in chemistry, their high score is due, not to their own achievement but to other students' **lack** of achievement. Conversely, a school's low score in literal comprehension may be primarily due to the fact that, in general, students across the state perform very well on questions that call for literal comprehension. When almost all questions are answered correctly, a single incorrect answer can affect a score more dramatically than when fewer are answered correctly.

In order to correct this inherent limitation of scaled scores, proficiency levels were developed. As their name implies, these levels describe students' performance at different points on a scale that is related, but not identical, to the MEAP school and district scaled scores. In defining and reporting on these levels, the MEAP hopes to give schools, districts, and the public a better description of what students know and understand about each subject area tested.

The scale which was used to define student proficiency ranged from 650 to 2150, with a standard deviation of 300 points. On this scale, four levels of proficiency are defined: 950, 1250, 1550, and 1850. Descriptions for each level were developed by committees of Massachusetts teachers who were presented with sets of MEAP test questions (both multiple-choice and open-ended) that were answered correctly by a substantial majority of the students at a given level, but were answered incorrectly by students at the next lower level. The committees reviewed these sets of questions in order to identify and describe the common skills that differentiated one set from another.

The behavior which is attributed to students at each proficiency level in no sense defines all that the student can do. Our descriptions are, necessarily, bound by the questions which were asked in the assessment. Obviously, they do not cover ALL the concepts, processes, and skills that are typical of each subject. What we have done is use the test items as a way of knowing the students. However, as in the case of knowing any individual, there are facets of thinking and behavior that become apparent only in certain situations or contexts. In the present enterprise, the text questions act as contexts. In attempting to broaden our understanding of the students at each level, we have

supplemented this information by examining students' responses to the questionnaires. In general, however, we have grounded our inferences firmly to the information at hand. Finer interpretations of why students can and cannot perform at various levels are more appropriate to the classroom teacher, who deals directly with individual students.



950 = Level I

GRADE FOUR

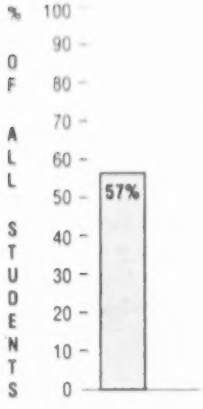
Students at this level are beginning to master the basic skills and concepts of the elementary school curriculum. They perform well when questions are set in contexts that they recognize as part of their experience and when material is presented visually.

GRADE EIGHT

Students at this level have mastered the skills and concepts of the elementary school curriculum; however, their understanding appears to be limited to the specific and practical. They perform best when questions are set in contexts that they recognize as part of their own experience.

GRADE TWELVE

Students at this level continue to perform best in a personal and practical context. They have acquired a set of academic skills that is useful in everyday life.



1250 = Level II

GRADE FOUR

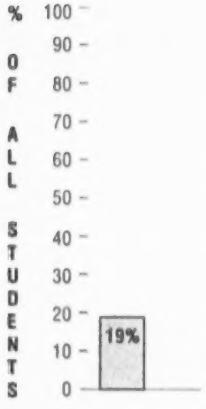
Students at this level are adept at the skills that constitute the main focus of the elementary school curriculum. Within familiar contexts, they show an ability to reason logically.

GRADE EIGHT

Students at this level have mastered much of the knowledge and skills that are typical of the taught curriculum. They are critical readers, evaluating material and recognizing assumptions. They are also adept at using visual material such as interpreting more advanced graphs, visualizing figures, and abstracting information from cartoons.

GRADE TWELVE

Students at this level show a greater maturity and a broader base of knowledge than eighth graders at the 1250 level; however, many of the characteristics of their thinking and some of their skills are comparable. In general, they are critical readers of text, but are less adept at integration and abstraction.



1550 = Level III

GRADE FOUR

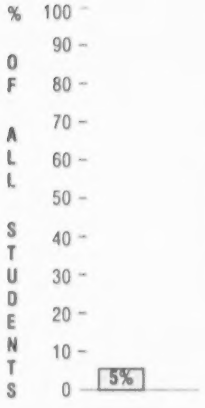
Students at this level are keen observers, paying attention to details. At the same time, they are beginning to think in terms of larger systems. This ability to recognize abstractions allows them the confidence and flexibility to reason through complex word problems, analyze content, and distinguish between necessary and irrelevant detail.

GRADE EIGHT

Students at this level think in terms of systems rather than discrete components. At the same time, they show a great attention to detail and a persistence in working through material. In addition, they are able to evaluate possible solutions by discriminating among nuances of meaning. They go beyond the taught curriculum to relate information from many sources.

GRADE TWELVE

Students at this level are primarily distinguished by their use of conceptual and logical analysis to solve problems. They also show a great attention to detail and can integrate information from the text itself, from other reading, and from their own experience in their construction of meaning. They possess a broad base of academic knowledge, both in history and in all major areas of science, and they are able to integrate and apply this knowledge to problem situations.



1850 = Level IV

GRADE FOUR

Students at this level have acquired a broad knowledge that goes beyond the taught curriculum and show an ability to use that knowledge as tools for logical analysis and reasoning.

GRADE EIGHT

Students at this level not only possess a broad base of detailed information about the subject areas tested, they are distinguished by their ability to analyze material and reason from it. Furthermore, in all areas, they possess an extensive vocabulary of technical terms that is appropriate to the subject.

GRADE TWELVE

Students at this level use a broad and detailed base of knowledge and understanding to solve problems and to construct meaning. They appear to have mastered all the elements of the secondary school curriculum in the subjects tested. They recognize the meaning of specialized terms in economics, as well as in other areas. Most striking is their independence in thinking.

Performance Across Subject Areas

On the previous pages is a general description of students at each level. The graphs next to each level show the average percentage of students who have attained the skills that characterize this level and above. For example, across the three grade levels tested, almost all students (approximately 89 percent) have attained the skills that are typical of the 950 level. The remaining 11 percent have not, with fewer students reaching this level at the twelfth grade than at the other grades. The majority of students (57 percent) have reached the 1250 level of proficiency or above, while 43 percent remain below this cut-off point. The other two levels are represented by far fewer students. For example, only an average of 19 percent of students have reached the 1550 level and 5 percent have reached the 1850 level of proficiency. In reviewing these capsule descriptions of students at the various levels of proficiency, it is apparent that students at the same level in different grades are characterized in much the same manner. This does not mean that they perform in identical ways. The material that they were responding to was appropriate for their grade level, and therefore, differed. It was their approach to the material presented that was similar. For example, although twelfth grade students at the 950 level are reading longer passages of more sophisticated content than fourth grade students at the corresponding level of proficiency, both have a minimal understanding of the content at their respective levels. Similarly, the amount of detailed information possessed by 1850 students at all grades suggests an intellectual curiosity that extends far beyond the taught curriculum.

Although the styles of thinking that characterize each level are similar across grade levels, the types of skills and content knowledge differ. In some cases, such as reading, there is a steady progression in the length and complexity of the material which students understand. In others, such as science and social studies, questions that were answered correctly only by students at the 1550 or 1850 level in a lower grade were answered by students at the 1250 or 950 level at a higher grade. However, this does not necessarily imply that the fourth grader at the 1550 level is displaying the same skills and understanding as the twelfth grade student at the 950 level. The following may help to illustrate how the same question may require different abilities at different ages.

When changes occur very quickly in a country, there is often conflict because

A. the changes were necessary.
B. the government has made careful plans to help people adjust.
C. no one obeys the new laws or follows the new ideas.
D. many people have difficulty adjusting quickly to new ways.

GRADE 4: 1550	GRADE 8: 1250	GRADE 12: 950
76% correct	71% correct	73% correct

For most students at grade four, the situation presented in this question is abstract and theoretical. Not only is the concept not explicitly taught, but the student must infer the answer from a limited knowledge of American or world history. The understanding of the concept of change shown by these fourth grade students reflects an ability to generalize from a limited set of examples. For twelfth graders, on the other hand, the response is more likely to represent factual information, knowledge that has been accumulated as a result of life experience or wider reading. The degree of

generalization is far less abstract. Although, in both cases, the responses may indicate an understanding of the concept of change, the fourth graders who answered correctly are relying on critical appraisal and thoughtful reading to a far greater extent than their older schoolmates.

On the other hand, in mathematics there is relatively little change in the skills and concepts which characterized eighth and twelfth grade students at the 1250 level. Although slightly more students at the twelfth grade are proficient with numerical procedures and basic algebraic ideas, the substance of the curriculum appears to remain the same. The items shown below, given at both grade levels, are examples of the kinds of thinking that are typical of these students.

If n is an odd number, which of the following is an odd number? (answer: n + 2)

GRADE 8: 1250 level	GRADE 12: 1250 level
66% correct	74% correct

James and his friends were playing a game. Before his turn, James had 14 points. He lost 19 points during his turn. On his next turn, James won 7 points and lost 6 points. How many points does James have?

GRADE 8: 1250 level	GRADE 12: 1250 level
83% correct	91% correct

How to View the Proficiency Levels

The description for each level indicates what is particularly distinctive about students' performance at that level. By implication, it also indicates what students at the lower levels **cannot** do. For example, 91 percent of fourth graders can read simple passages, apply common sense to problems, and work with visual material (950 level of proficiency). Conversely, however, these figures indicate that 9 percent of the fourth graders have not reached this level.

Perhaps more informative is the next level (1250), which represents the majority of the student body. While slightly more than half the students have attained the basic curriculum taught, the limitations of thinking on the part of these students is best illustrated by looking at what they **cannot** do, (i.e., examining the 1550 level of proficiency). Below are some examples that illustrate the difference between the 1250 and the 1550 levels of achievement in mathematics and science at grade twelve.

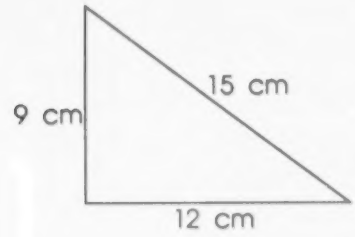
Why are most of the oldest life forms still living on earth found in the ocean?

(Correct response: The undersea environment has been relatively stable over time.)

Correct at 1250 level:	Correct at 1550 level:
41%	78%

At the 1250 level slightly less that a quarter of the students believed that the oldest life forms are found in the ocean because salt water acts as a preservative. Slightly more suggested the reverse: that underwater life forms have changed more over time to adapt to their environment.

What is the area of this right triangle?



(Correct response: 54 cm^2)

Correct at 1250 level:	Correct at 1550 level:
23 %	71%

This question does not require the knowledge of a computational formula. It requires the student to recognize that the figure given is one-half of a rectangle and, consequently, the area will be half the area of a rectangle with sides of 9 cm and 12 cm. A quarter of the twelfth grade students at the 1250 level multiplied all the numbers given; another 30 percent added them.

Both questions illustrate the tendency of the 1250 students to stay within the realm of the taught curriculum, particularly in the areas of mathematics and science. They find it difficult to apply their knowledge to problems which do not conform to those which they find in their textbooks or contain material other than that which has been explicitly taught.

TABLE 1: PERCENTAGE OF STUDENTS AT EACH LEVEL OF PROFICIENCY AND ABOVE

Grade 4	Reading	Mathematics	Science	Social Studies
950	91	95	94	93
1250	59	60	61	59
1550	21	14	16	17
1850	2	3	2	2
Grade 8				
950	85	90	89	88
1250	57	55	57	56
1550	25	20	20	21
1850	8	5	4	5

Grade 12	Reading	Mathematics	Science	Social Studies
950	82	84	87	84
1250	57	53	55	54
1550	28	23	22	23
1850	9	8	6	7

Factors Affecting Performance

It is obvious from the table above that differences in proficiency become more attenuated as students progress through school. For example, whereas only 9 percent of students have not reached the basic reading proficiency level (950 level) in grade four, 18 percent are below that level at grade twelve. Likewise, while only 2 percent of fourth graders are at the 1850 level in reading, 9 percent have attained this level by grade twelve. This reflects a common trend in achievement whereby students' abilities become more differentiated with age and education. On the other hand, it is also useful to look at some of the characteristics that distinguish between students at various proficiency levels. In order to better understand what characterizes students who perform at these levels, their responses to the questionnaires were used to characterize each type of student.

The analysis of the questionnaires according to the responses from different groups of students reflects the general trends that we have noted before. The same factors are related to achievement. However, when we look at different groups, some aspects come into sharper focus.

Fourth Grade Students

Students at the fourth grade level answered similarly to most of the questions asked them as part of the assessment. However, there were some significant and interesting differences. These are noted below.

Percentage at each reading proficiency level

	1850	1550	1250	950
Computer at home	55	49	41	32
Attended preschool	80	77	68	54
Read on their own every day	70	60	49	40
Like science	59	58	54	49

These differences, which are given with reference to students at different levels of reading proficiency, become greater when proficiency in other subjects is examined. For example, **access to a computer** is even more significantly related to math performance, where 62 percent of students at the 1850 level replied that they had use of a computer. Not surprisingly, **liking science** is also more related to science performance than it is to reading. Whereas 66 percent of students at the 1850 level replied that science is one of their favorite subjects, only 44 percent of their classmates at the 950 level agreed. Attendance at preschool also appears to have a stronger positive affect on

math and science performance than it does on reading performance, perhaps because of the opportunities for hands-on experiences afforded by preschool groups.

Eighth Grade Students:

Large differences among students at different proficiency levels occurred in terms of their attitude toward the subject areas. However, some other differences were also apparent. For example, 62 percent of students at the 1850 level of science proficiency replied that they had **access to a computer** at home compared with only 33 percent of the students at the 950 level. Likewise, 67 percent of students at the 1850 level of reading proficiency replied that they personally owned more than 30 books. Students at this age are also becoming more differentiated in their abilities, particularly in regard to language arts versus mathematics. In mathematics, tracking affects students' performance. Seventy percent of students who performed at the 1850 level in mathematics were taking algebra, in contrast to 39 percent at the 1550 level, and very few at the other proficiency levels.

Other responses which distinguished among students are listed below. In each case the proficiency levels refer to the subject which is the focus of the question.

Percentage at each proficiency level in their attitudes toward:

	1850	1550	1250	950
Mathematics as:				
unrelated topics	14	18	26	35
mainly memorizing	38	54	60	71
Science as:				
unrelated topics	17	28	32	38
mainly memorizing	37	48	47	49
useful	51	43	38	33
interesting	44	34	22	15
Social Studies as:				
mainly memorizing	56	57	62	65
hard to understand text	14	19	29	37

How subjects are perceived by students becomes a more significant factor in their achievement at grade eight than at the earlier grades. Students at the 1850 and 1550 levels of proficiency consistently replied that they found the subject matter interesting. In addition, these students also appear to recognize the larger trends and unifying structure of the subjects than do their peers. For this reason, they do not have to rely on memorization to the same extent as their classmates. As far as the questionnaires were able to investigate, instructional practices appear to be similar for all groups, although there is a trend for more discussion, analysis, and writing to be associated with higher levels of achievement. The exception is in science, where twice as many students at the 950 level (approximately 35 percent) stated that they never performed experiments as part of their instruction. These students also report being tested more often than their classmates, which may suggest an emphasis on content rather than process in their science instruction, thereby confirming their

perception of science as mainly memorization. (See discussion in *The Massachusetts Educational Assessment Program: 1988 Statewide Summary*, 1988, Chapter 4.)

Twelfth Grade Students:

As was the case in the earlier grades, certain opportunities, such as access to a computer and a personal library of more than 30 books, continue to be related to high achievement. Among students at the 1850 level of science proficiency, 62 percent used a computer at home, in contrast to 35 percent at the 1250 level and 30 percent at the 950 level. Fifty percent of students at the 1850 level of reading proficiency owned more than 30 books, in contrast to 26 percent at the 950 level.

However, important differences at this level are related to course-taking. Table I gives some indication of the spread in achievement at grade 12. By now, students have also become more sharply differentiated by their course work and attitudes toward the subject areas tested.

Almost all students at the 1850 level are enrolled in college preparatory and advanced placement courses. Although many of the students who perform at the 1850 level in one subject are at the same level in others, this is not universally the case. Students who are at the highest proficiency level in reading are a more varied group than those in math and science who, in general, have distinctive attitudes and aspirations. Seventy-two percent intend to take more math courses, 62 percent intend to continue their study in science, and 31 percent plan to prepare for a career in science.

High scores in mathematics and science are related to advanced course work. Over half of the students at the 1850 level in mathematics are studying pre-calculus or calculus, with another 20% studying trigonometry. Among the highest achievers in science, about half are taking physics and a quarter are taking chemistry.

The extent to which students believe mathematics and science to be difficult does not appear to be a significant factor in achievement: the majority of students at all levels of proficiency find the subjects difficult. Despite this, students at the higher levels are more inclined to be very interested in the subjects tests, particularly so in regard to science. Students at the 1850 level also appeared to recognize the logic of mathematics and structure of science, relying far less on memorization that other students.

It is not surprising, given the difference in course content, that different instructional practices are reported by the different groups. For example, students at the 1850 proficiency level are most likely to use a calculator in their work. Slightly less than half use it every day and another quarter use it several times a week. In contrast, only a quarter at the 1250 level use it every day and 30 percent never use it. Students at higher proficiency levels in reading report spending more time studying literature and also report more discussion and analysis in class. They also tend to be assigned longer papers than students at the lower levels of proficiency. Reading continues to remain a problem with many students: approximately half of students at proficiency levels 950 and 1250 find difficulty in reading their textbooks.

Percentage of students at each level who state that they are very interested in the subject:

	1850	1550	1250	950
Mathematics:	39	25	14	13
Science:	45	25	13	8
History:	39	26	16	10

Percentages of students at each level who see subjects as useful:

Science:	49	38	28	26
Social Studies:	57	42	31	22

Percentages of students at each level who see subjects as mainly memorizing:

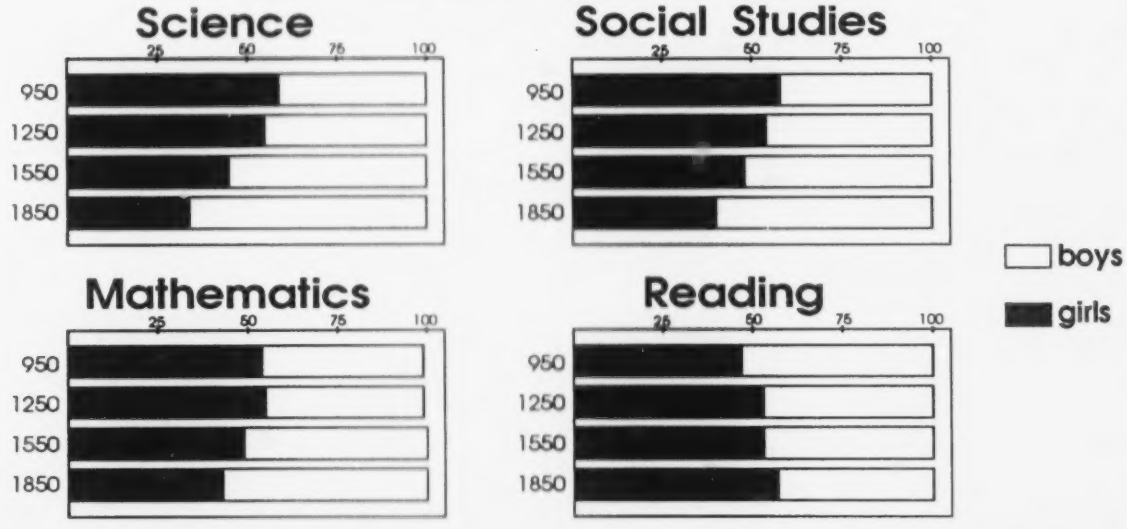
Social Studies:	41	51	61	64
Mathematics:	32	41	53	57
Science:	31	39	47	48

Gender differences:

The increasing differentiation among students that we noted in terms of achievement can also be observed in terms of gender. At the eighth grade level, boys predominate at the highest levels of proficiency in all areas except reading. The difference is particularly apparent in the area of science, where there are 30 percent more boys than girls at the 1850 level; however, there is also a 14 percent difference in favor of boys in social studies.

These differences become more attenuated in twelfth grade. By this age, the difference at the 1850 level has increased to 32 percent in science, 20 percent in social studies, and 14 percent in mathematics. Girls outnumber boys by 14 percent in the language arts.

TABLE 2: GENDER DIFFERENCES: GRADE 12



Level of parental education:

As has been noted previously, there is a very strong relationship between school achievement scores and parental education. The strength of this relationship is reflected in the Comparison Score Bands which are used to report school and district scores. Likewise, there is a moderately strong relationship between individual students' achievement scores and parental education—the higher the educational level of students' parents, the higher those students tend to score on the assessment tests. However, this analysis of the characteristics of students at each proficiency level, clearly indicates the limitations of using averages (i.e., school scores) to predict the achievement of individual students.

At both grades eight and twelve, there are many students who reported that their parents did not have a four-year college education. On average, only approximately half the students at the 1850 level of proficiency reported that their mother had graduated from college, with slightly more reporting that their father had done so. The level of parental education appeared to be strongest in mathematical proficiency, weakest in the language arts. In general, the strength of the association between level of parental education and level of proficiency appears to be no stronger that which has been noted for some of the other factors discussed above.

APPENDIX A

DESCRIPTIONS OF STUDENT PERFORMANCE AT LEVELS OF PROFICIENCY

GRADE FOUR

950

General characterization: Students at this level are beginning to master the basic skills and concepts of the elementary school curriculum. They perform well when questions are set in contexts that they recognize as part of their experience and when material is presented visually.

Reading: They are adept at reading simple, short passages that are supplemented by graphics. Although they can locate information within the text, their inferences are based upon common sense rather than upon material found in the passage. Their vocabulary is limited to simple, commonly-used words.

Mathematics: They have mastered basic arithmetic facts and operations, recognize the relative size of numbers, and can solve simple, one-step problems.

Science and social studies: In these areas they appear to rely more upon their own experiences and common sense than upon classroom instruction. Although they show familiarity with common scientific facts that are the typical focus of children's literature and television, they appear to have much more limited knowledge of the society about them.

1250

General characterization: Students at this level are adept at the skills that constitute the main focus of the elementary school curriculum. Within familiar contexts, they show an ability to reason logically.

Reading: Their reading material is no longer limited to simple short passages, but they are able to remember details and make simple inferences concerning narratives of some length and complexity.

Mathematics: They are adept in carrying out operations with whole numbers and simple decimals. They can translate simple word problems into number sentences and can solve multi-step word problems involving addition and subtraction. In addition, they can read and interpret frequency graphs and scales.

Science and Social Studies: They exhibit an understanding of the more fundamental ideas of the subject areas, such as roles and social groups in social studies, animal classification, and states of matter in science. They also have some familiarity with basic research concepts in both areas.

1550

General characterization: Students at this level are keen observers, paying attention to details. At the same time, they are beginning to think in terms of larger systems. This ability to recognize abstractions allows them the confidence and flexibility to reason through complex word problems, analyze content, and distinguish between necessary and irrelevant detail.

Reading material: Their reading ability is such that they can view passages in their totality, rather than as a sequence of events. When presented with complex and detailed material, they do not lose their way, but can evaluate information and make judgments, distinguishing the best response among a set of plausible ones.

Mathematics: These students are beginning to view number in its own right, not solely as the property of things. They recognize number sequences, patterns, and simple functions and are beginning to have a sense of variables.

Science: Although these students have a much broader knowledge level than students at the 1250 level, they can go beyond mere scientific facts to show an understanding of such fundamental concepts as the function of organs and the effect of gravity.

Social Studies: Showing a greater awareness of community, levels of government, and cultural diversity, these students also appear to have a sense of the past, recognizing the sequence of historical events.

1850

General characterization: Students at this level have acquired a broad knowledge that goes beyond the taught curriculum and show an ability to use that knowledge as tools for logical analysis and reasoning.

Reading: They are adept readers, with a large vocabulary and consciousness of themselves as readers. They can read a wide range of fiction, factual material, and simple poetry, and are beginning to recognize such formal aspects of language as poetic conventions and imagery.

Mathematics: These students can reason numerically. They recognize simple mathematical symbols and show a knowledge of basic statistical concepts.

Science: They show a deeper understanding of underlying concepts and relationships. They are able to analyze, reason, evaluate, and synthesize.

Social Studies: They show clear reasoning ability: inferring from data, recognizing assumptions, and justifying their responses. Their knowledge of history goes beyond the recognition of benchmark dates to indicate an understanding of some underlying historical currents, as well as a sense of time.

GRADE 8

950

General characterization: Students at this level are have mastered some of the skills and concepts of the elementary school curriculum; however, their understanding appears to be limited to the specific and practical. They perform best when questions are set in contexts that they recognize as part of their own experience.

Reading: Their level of reading is characterized by high-interest informational material. Although they can locate information within these texts, their inferences are based upon common sense rather than upon material found in the passages.

Mathematics: These students are proficient with operations of whole numbers and can translate simple word problems into number sentences. They are adept at visual tasks—interpreting frequency graphs and recognizing common geometric shapes.

Science and Social Studies: They are knowledgeable about those aspects of the subjects that apply to their personal lives, i.e., nutrition in science and personal rights in social studies.

1250

General characterization: These students have mastered much of the knowledge and skills that are typical of the taught curriculum. They are critical readers, evaluating material and recognizing assumptions. They are also adept at using visual material such as interpreting more advanced graphs, visualizing figures, and abstracting information from cartoons.

Reading: They are active readers of a wide range of both narrative and informational passages, making inferences about character and motivation and identifying assumptions. They recognize of some of the formal aspects of reading, such as the purpose of different typographical conventions (e.g., italics).

Mathematics: They show confidence in applying operations with decimals and fractions and can solve multi-step word problems, including those with integers. They recognize variables, can evaluate expressions, and use formulas.

Science: They can go beyond the everyday aspects of science to recognize instances of basic scientific concepts (e.g., evaporation and condensation) and to related individual elements within a system. They are also familiar with scientific convention and survey techniques.

Social Studies: These students possess a general knowledge of the world about them, as well as knowledge of history and government. They also show an understanding of some basic social studies concepts, such as the effects of change.

1550

General characterization: These students think in terms of systems rather than discrete components. At the same time, they show a great attention to detail and a persistence in working through material. In addition, they are able to evaluate possible solutions by discriminating among nuances of meaning. They go beyond the taught curriculum to relate information from many sources.

Reading: These students are fluent readers and can handle difficult vocabulary. They appreciate the purpose and function of writing conventions and author's voice.

Mathematics: In addition to a thorough knowledge of numerical operations and understanding of basic numerical concepts (decimals, square roots) that are part of the eighth grade curriculum, they can reason numerically.

Science: These students show a deeper understanding of scientific concepts by relating those concepts to a variety of situations that are different from the contexts in which they are taught. They can draw conclusions based on careful analysis of data and can evaluate experimental designs.

Social Studies: These students go beyond the facts and taught definitions of the curriculum to recognize the underlying concepts. They can interpret and integrate information from different sources, including unfamiliar graphs and charts.

1850

General characterization: These students not only possess a broad base of detailed information about the subject areas tested, they are distinguished by their ability to analyze material and reason from it. Furthermore, in all areas, they possess an extensive vocabulary of technical terms that are appropriate to the subject.

Reading: These students can make fine discriminations in meaning. They recognize nuances in meaning and tone of voice and have a sophisticated understanding of craft of writing — poetic forms, irony, and stylistic devices.

Mathematics: These students understand basic algorithms and problem solving strategies. Unlike students at the previous level, they are adept at using proportional reasoning in their analysis of problems.

Science: These students possess a great store of detailed science information, which they can synthesize when presented with a problem. They can analyze systems and discover relationships.

Social Studies: These students possess detailed historical information. They are familiar with technical terms, such as scapegoating and lobbying. They are critical readers, recognizing assumptions and biases, as well as being thoughtful writers, synthesizing information and ideas from a number of different contexts.

GRADE 12

950

General characterization: Students at this level continue to perform best in a personal and practical context. They have acquired a set of academic skills that are useful in everyday life.

Reading: Their reading material consists of high-interest informational material and narrative passages that deal with human relationships. They can locate information within these texts, interpreting words in context and recognizing some figurative language.

Mathematics: In addition to the basic operations, they can add and subtract integers and can use coordinates to read charts. They can recognize variables and evaluate expressions.

Science: They are familiar with basic scientific concepts, such as forms of matter and the elements of a food web, as well as everyday aspects of health.

Social Studies: Having accumulated a store of knowledge about the history and structure of society, they are able to use it in reasoning about real-life situations. They are also able to read and interpret graphical information, and possess a knowledge of place geography.

1250

General Characteristic: Students at this level show a greater maturity and a broader base of knowledge than eighth graders at the 1250 level; however, many of the characteristics of their thinking and some of their skills are comparable. In general, they are critical readers of text, but are less adept at integration and abstraction.

Reading: They show an understanding of a wide and sometimes stylistically difficult range of passages in history, sociology, and current events. They are able to summarize the main points of the articles, recognize assumptions, and evaluate the material presented. They can make inferences about character and motivation. They can actively construct meaning and recognize authors' assumptions. In addition, they can recognize the purpose of different typographical conventions (e.g.,italics).

Mathematics: These students are adept at basic operations with whole numbers, fractions, and integers, and can and perform basic algebraic manipulations, but appear to have little understanding of more abstract concepts or mathematical reasoning.

Science: They have a broad based knowledge of concepts in the area of life science and can answer questions that are typical of work in biology beyond the basic level. They do not show the same breadth of knowledge in the physical sciences. They also appear to have a fundamental understanding of the nature of science.

Social Studies: Their broader knowledge base and more proficient reading level allows them to display the kind of critical, active reading that is important to the subject. They show also a knowledge of current events and factual modern history, as well as an understanding of fundamental civic concepts such as representative democracy.

1550

General Characteristics: These students are primarily distinguished by their use of conceptual and logical analysis to solve problems. They also show a great attention to detail and can integrate information from the text itself, from other reading, and from their own experience in their construction of meaning. They possess a broad base of academic knowledge, both in history and in all major areas of science, and they are able to integrate and apply this knowledge to problem situations.

Reading: These students are adept readers of detailed technical material. At the same time, in their reading of more general literature, they show an appreciation of figurative language and the use of author's voice. Their vocabulary is extensive, including both sociological and economic terms, as well as figurative terminology.

Mathematics: These students understand mathematical concepts, such as scientific notation and integers, and are adept at using both geometric knowledge or algebraic manipulation to solve problems. They show evidence of an algebra curriculum.

Science: Students at this level display a knowledge of basic information in the physics, chemistry, and earth science curriculum. On the other hand, what is most evident about these students is their ability to analyze questions at a fine level of detail, to evaluate, and to apply reasoning skills.

Social Studies: These students show a broad knowledge of current events, civics, and modern history, as well as a knowledge of ancient civilizations. More important, they are able to integrate this information in response to specific situations.

1850

General Characteristic: These students use a broad and detailed base of knowledge and understanding to solve problems and to construct meaning. They appear to have mastered all the elements of the secondary school curriculum in the subjects tested. They recognize the meaning of specialized terms in economics, as well as in other areas. Most striking is the independence in thinking.

Reading: They are thoughtful readers, recognizing and rejecting stereotypical conclusions. In addition, they are able to distance themselves from the meaning of the text to take into account the craft of writing itself.

Mathematics: These students possess great computational fluency, as well as evidence of understanding of more advanced mathematical topics. They show an unusual flexibility in problem solving, using divergent thinking strategies to tackle unfamiliar problems.

Science: The ability to grasp more complex scientific principles and to apply them in experimental and practical contexts is typical of these students. They exhibit an understanding of the scientific process by applying the principles of science in both experimental and practical contexts.

Social Studies: Students at this level are primarily distinguished by their detailed knowledge of history and governmental processes. They are able to abstract information from different sources and apply it to unfamiliar contexts.

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